SUNRISE
SUN RADIO INTERFEROMETER SPACE EXPERIMENT

# SunRISE PM Lessons Learned
# PI Forum
# 7 Nov 2023

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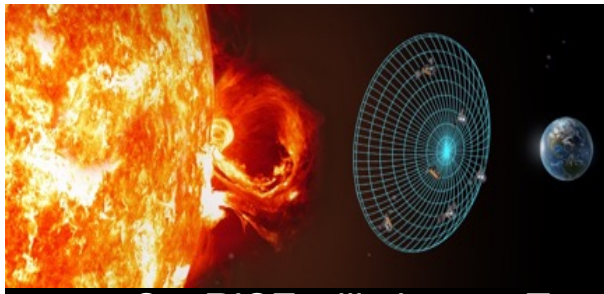

# SunRISE Status as of 1 Nov 2023

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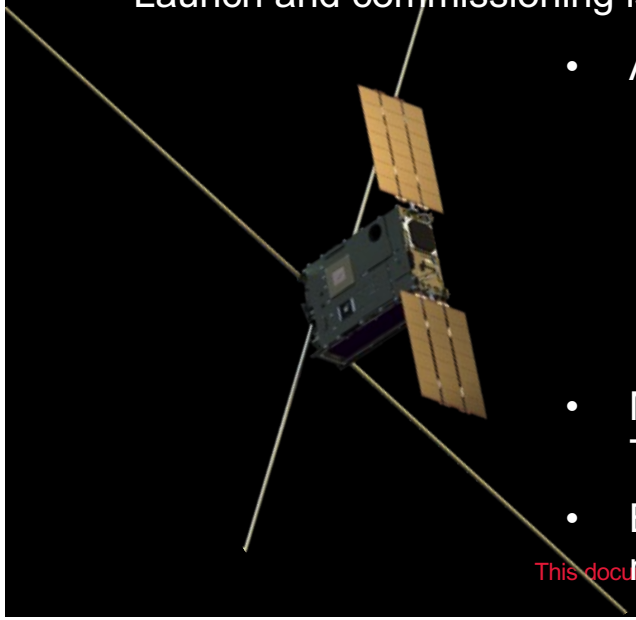
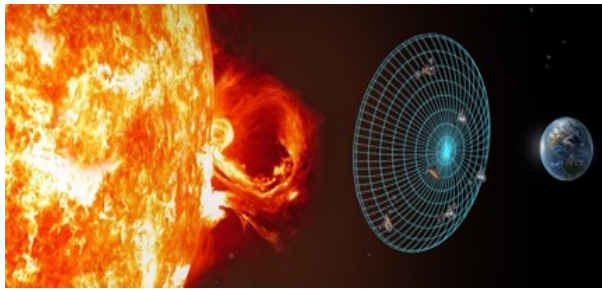
- SunRISE will observe Type II and Type III radio bursts from the Sun at 100 kHz to 23 MHz
- Six 12 kg 6U space vehicles form a ~10km aperture radio interferometer just above Geosynchronous orbit.
- Launch and commissioning is planned for late 2024 – mid 2025.



- All Space Vehicles assembled and through TVAC and EMI/EMC.
  - Design defect discovered in purchased Space Micro processor card (CSP) that's part of payload. Rework and retest completed in October 2023.
  - Vibration testing deferred until launch loads are known – expect to test early 2024
- Mission and Ground systems had a successful Operational Readiness Test-3 in May 2023.
- Bathtub began in June 2023. (except Payload rework) – Bathtub ends L-5 months



# Programmatic Risk

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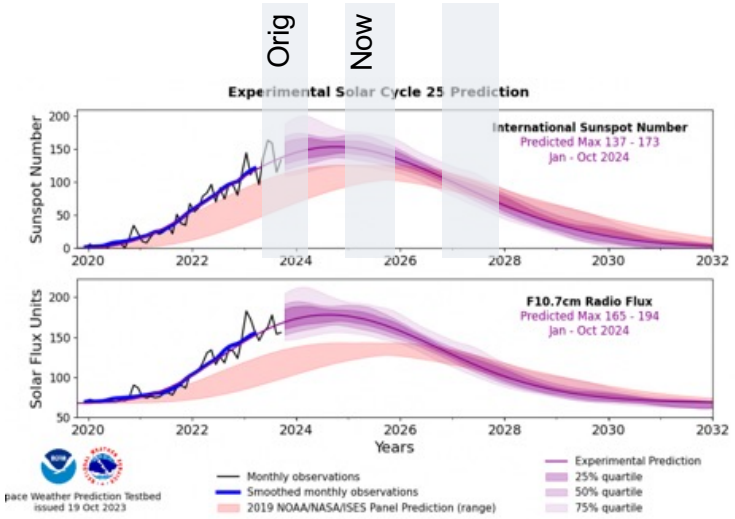
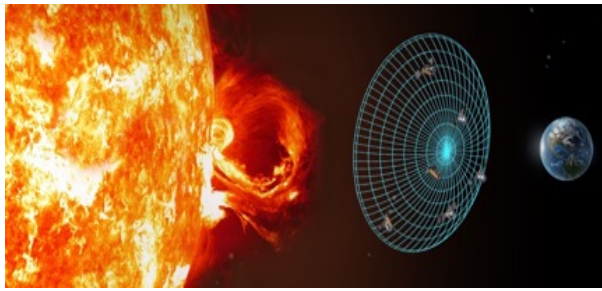
- TMC reviews (and SQRLs) are big part of Step 2
- I'll assume you've got the "technical" part figured out
  - Watch out for "hidden development risk" – Sure it's flown before. It's past TRL-6, but…..
- Cost and Schedule Risk
  - Reviewers are looking for knock-on or consequential impacts on cost/schedule
  - What happens when the schedule (inevitably) breaks?
    - Marching Army costs while you wait for a late completion
    - Resource constraints (facilities, workforce)
    - Science consequences of delay (SunRISE looks at CMEs, Solar Max is important)





# Budgets and Change Control

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- As you iterate your budget and schedule while you write your CSR
  - Keep track of changes, especially ***why*** the change was done, and who was involved (emails, etc.), and when.
  - Especially important coming down to the wire when you're doing those last reviews and you're working to come in "under the cap".
  - Watch your technical margins – you'll probably come in at 25% cost reserves, so you need those margins
- You WILL get questions about your basis of estimate and plan in the Site Visit
  - Need to be able to respond quickly and accurately
- When you do your plans at KDP-B, you're going to find discrepancies
  - For SunRISE we had work that was bookkept in one WBS that wound up being actually done in another WBS, and it got dropped.
  - Helps to answer the "what were they thinking?" question

# Schedule delays and bathtubs

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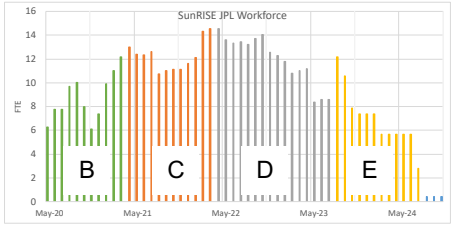
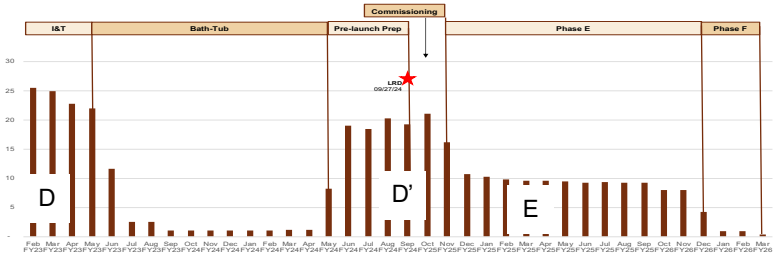
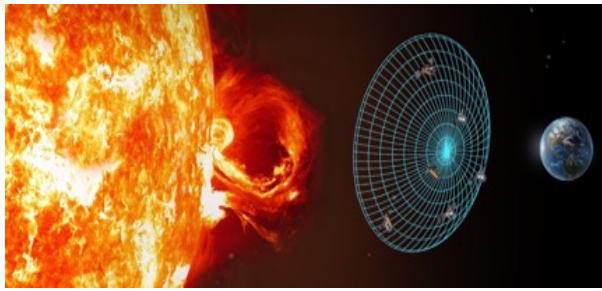
- There will be delays, either externally or internally caused
  - Have a defined plan for dealing with it (back to the Marching Army) so the cost impact can be (approximately) quantified
- Launch delays are a fact of life, particularly if you're ridesharing
  - If you've planned a bathtub, describe your plan and show your "bathtub burn rate" ($/month), and whether it's "covered in the plan" or "covered by UFE/reserves"
  - Does the plan change if the bathtub length gets much longer (e.g. 2 years instead of 6 months) – is there periodic maintenance? (item for risk list)
  - Be able to defend your workforce roll off – reviewers will assume you can't downsize as quickly as you think





# Expect Anomalies

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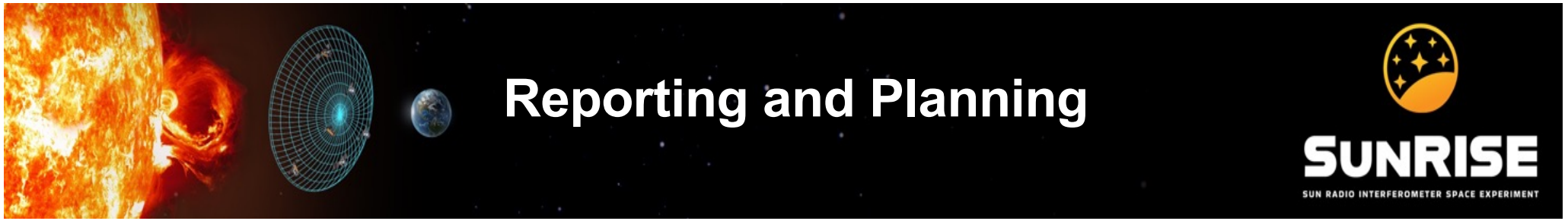
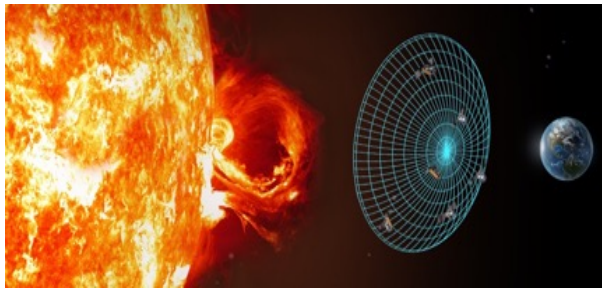
- SunRISE had (at least) 6 unexpected events & occurrences
  - COVID
  - Propulsion flow anomalies, leaks, manufacturing
    - Inexperience of designers missed potential problems, caught in test, significant analysis and manufacturing process changes required. Delayed delivery of propulsion to integration by 6-7 months
  - Frangibolt® failure in non-flight unit
    - Prompted closer look and discovered underlying component manufacturing issues
  - Payload preamp oscillation
    - Test campaign didn't catch it until late – needed redesign; delayed delivery of payloads to integration
  - Off-the-shelf space-qualified computer board with design defect
    - Discovered very late (final SV I&T campaign) – required us to fix design and do rework
  - Access to Space
    - Our original rideshare (that we were paying for) evaporated
- Each consumed months, disrupted the flow of the schedule, and had significant cost impact




# Reporting and Planning

- Reporting takes more resources than expected
  - SunRISE is about 2 FTE just to keep up with all the reporting (we planned ~0.75)
    - Every stakeholder has their own preferred format and content
    - The basic data is the same, just different formats, order, analysis
    - Space Dynamics Lab (SDL) our Spacecraft vendor and doing System I&T had to add an FTE
  - PM spends more time “managing up” than “managing down”
    - Having a good deputy or flight system manager to manage down is essential
  - You’ll get requests for *ad hoc* reporting a few times a year
- Assume you’ll need to do a cost and schedule exercise (or replan) once a year
  - Consumes a month or so of project business team and WBS element leads at ½ FTE
  - Usually driven by either a KDP or an unexpected event (see previous slide)



# Cybersecurity

## Mission Resilience and Protection Program (MRPP)

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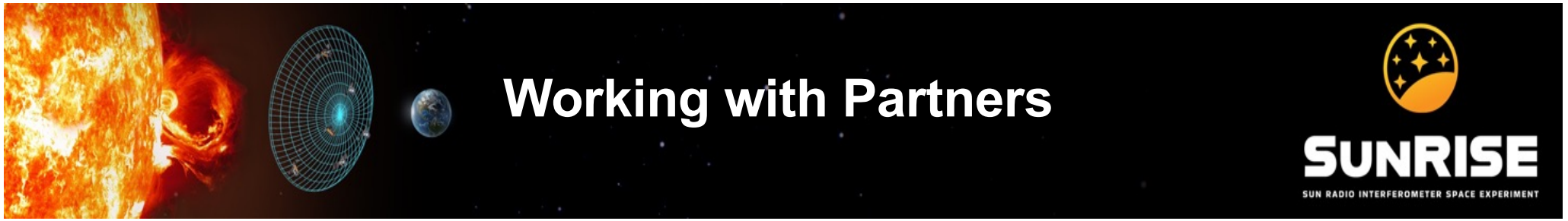
- Plan for it – there are no waivers
  - Consider system boundaries very carefully – each “chunk” has different risk ratings and required controls
  - It’s a continuing activity, so plan for maintenance, reassessment, etc.
  - The rules will change – who pays for that? Give your assumption in the CSR.
- NASA STD-1006A – command stack protection (aka uplink encryption)
  - Validate that an off the shelf solution actually works
  - Lots of people sell radios with encryption to DoD – but does that work with YOUR ground stations?
  - (It sure doesn’t with DSN and DoD compatible radios don’t use CCSDS protocols)
- But crypto is a tiny part: Cybersecurity has things that affect everything
  - Find someone really experienced at this and it’s straightforward and not too expensive (SunRISE <$1M)
  - There’s a LOT of interpretation and wise decisions needed – it is not taking NIST 800-53 as a cookbook with 600+ check boxes
  - SunRISE experience with NASA HQ and JPL has been very good – but you have to know your stuff


# Other Gotchas

- The AO and NPR 7120.5 F have some new requirements
  - Cyber (previous slide)
  - CARA (Collision Avoidance)
    - Need preliminary Orbital Collision Avoidance Plan (OCAP) by PDR, but...
    - Also need to address disposal and collision avoidance in CSR.
  - Class D – SPD 39 – SMD Mission Assurance Requirements for Payload Classification D
    - Not a “get out of jail free” card by any means
    - For each thing you don’t do, you’ll need justification as to why it’s acceptable risk and you’ll have to sell it to reviewers, independent assessors, etc.
    - Watch out for “implied requirements” from institutional test processes, etc.




- It's all about mutual trust.
- Plan time and travel for face to face interaction at multiple levels.
  - Tech Interchange Meetings – ensure there's both "formal work" and "informal discussion"
  - People will tell you things in person they're concerned about that they'd never say in a teleconference or email.
- Create an Executive Advisory Board
  - People a layer or two above you and the manager at your partners, e.g. senior management, VP level, etc
  - They can help with resource allocation when you get into a sticky spot and you need to displace the 800 lb gorilla : SunRISE used this 3 or 4 times
  - Keep them aware of what's going on – not an every month reporting task, but just so they know who you are and what you're doing – this might happen incidentally, but if there's something looming, make sure it trickles up.
- Be aware of their institutional scheduling peculiarities
  - Something as simple as alternating Fridays off might be "out of phase"
  - Academic institutions in particular – will you lose workforce due to graduation?
  - Maybe not on your original plan, but what if the schedule slips?
  - SunRISE lost the science pipeline lead a couple years after he got his PhD.
  - Propulsion at Georgia Tech lost people to graduation, in the middle of problem resolution.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